DOCUMENT RESUME

ED 297 938 SE 049 184

AUTHOR Stanic, George M. A.
TITLE Cultural Influences on Mathematics Performance and Their Role in Research on Equity in Mathematics Education.
PUB DATE 88
NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 5-9, 1988).
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cross Cultural Studies; *Cultural Influences; *Educational Research; Elementary Secondary Education; Females; *Mathematics Achievement; Mathematics Education; *Mathematics Instruction; *Sex Differences; Socioeconomic Status; Sociology
IDENTIFIERS *Mathematics Education Research

ABSTRACT

The document is intended to provide direction for research in mathematics education related to sex equity which will take more seriously the notion of cultural influences on performance. The relationship between culture and schooling is explored, and the necessity of studying culture is argued. The paper concludes with the idea that there is a need to use ideas in studies about sex differences in mathematics which look outside the school and attempt to study the relations between the culture inside and outside the schools. (PK)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED297938

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

George M.A. Stanic

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

# Cultural Influences on Mathematics Performance and their Role in Research on Equity in Mathematics Education

George M. A. Stanic

University of Georgia

Paper presented at the annual meeting of the American Educational Research Association, April 1988, New Orleans.

SE 049 184

"Smart women like sports." That, at least, is the opinion of J. E. Vader (1987), a woman who writes for Sports Illustrated. "I'm convinced," says Vader, "[that] sports help make girls smart." She is quick to add that "because virtually every American boy is programmed to play and watch sports, it's nonsense to state 'smart men like sports.' If you doubt this," she says, "simply attend any game in Yankee Stadium." She goes on in her editorial to speculate about the connection between familiarity with sports and skill in mathematics, pointing to a causal connection from the former to the latter. The remainder of her article includes numerous examples of the mathematical benefits of participation in sports.

My point in mentioning Vader's presentation of anecdotal evidence in support of her claim that smart women like sports is that researchers in the field of mathematics education who are interested in sex, race, and social class differences in performance have not gone much beyond this same sort of intuitively appealing speculation about cultural determinants of group differences. Mathematics educators are learning more and more about school culture, but the culture outside of school has been neglected in our work. We cannot leave the study of culture and society only to anthropologists, sociologists, and a few cognitive psychologists.

We do, however, have something to learn from the research literature on culture. My purpose in this paper is

to provide some direction for research in mathematics education which will take more seriously the notion of cultural influences on performance.

## Schooling and Culture

Much research on equity, especially in the area of sex differences, has demonstrated the important influence of schools in general and classroom processes in particular on group differences in achievement (Becker, 1981; Fennema & Meyer, in press; Fennema, Reyes, Perl, & Konsin, 1980; Meyer & Fennema, 1988; Reyes, in press; Reyes & Stanic, 1988; Tobin, 1984). However, there is also work in mathematics education which demonstrates that schooling alone cannot account for such differential achievement; in fact Senk and Usiskin (1983) made an even stronger claim.

Senk and Usiskin (1983) studied 1,364 students in 74 high-school classes and found that males and females had equal ability to write geometry proofs. This result was true even for high-achieving subsamples. The Senk and Usiskin study is particularly important because writing geometry proofs requires some spatial abilities and because writing geometry proofs is a high-level cognitive task. (Males tend to score higher than females on tests of spatial abilities, and the greatest sex differences in mathematics performance are on high-level cognitive tasks. See Stanic, 1988, for a discussion.)

Senk and Usiskin concluded by asking: "Why do some studies show great sex differences in mathematics performance whereas others do not?" (p. 197). They answered their question as follows:

> Our explanation relies on comparing the test items with students' formal and informal educational experiences. When test items cover material that is taught and learned almost exclusively in the classroom, no pattern of sex differences tends to be found. (p. 197)

And, according to Senk and Usiskin, "geometry proof writing is unlikely to be encountered even by the most interested student outside of geometry classes" (p. 198). So, "when experience can be controlled, regardless of the difficulty or complexity of the items, girls and boys perform equally well" (p. 199). Smith and Walker (1988) supported Senk and Usiskin's claim in a study of 9th, 10th, and 11th graders who had taken the New York State Regents mathematics examinations. The point is that Senk and Usiskin's conclusion deserves more attention. At the very least, it should make us look more closely at the culture outside of school.

## Studying Culture

It seems to me that a significant problem in studying cultural influences on sex, race, and social class differences in mathematics performance is the assumption that "culture" is a clearly definable, independent variable

that we can look to as a unique source of effects. But culture does not send one set of clear and consistent messages. Even more important, it is problematic to consider human culture as separate and independent from human biology--given the evolutionary effects that biology and culture have had on each other.

But whatever the long term relationship has been between human biology and human culture, we may need to think of culture as an independent variable because it is one over which we have some control. My ideas here are related to what Lester Frank Ward (1883) said in the late 19th century in response to conservative social Darwinists such as Herbert Spencer, who essentially argued that the present conditions of society reflected the same "survival of the fittest" idea that characterized biological evolution. Rejecting the idea that the present conditions of society are inevitable (and the implication that we should let things take their "natural" course), Ward claimed that the most significant fact about human evolution is that we have evolved to a point where we can control our destiny. Ward believed, for example, that there were no differences between the sexes in terms of native capacity, and he argued that the greatest problem to be overcome by society was the unequal distribution of knowledge, or what he called the <u>social inheritance</u>. Perhaps naively, Ward thought that schools could overcome the injustice in our society by

creating a more equal distribution of the social inheritance he saw as so important.

Maintaining Ward's basic faith in human intelligence and in the potential role of schools, we need (especially in the field of mathematics education) to look more closely at the culture outside of school and its links and discontinuities with school culture. I believe there are at least two promising directions for research--one based on what has been termed culture-practice theory in cross-cultural studies of cognition (Laboratory of Comparative Human Cognition, 1983), the other arising from what has come to be known as critical sociology of education (e.g., Apple, 1979, 1982a, 1982b, 1986; Apple & Weis, 1983; Bernstein, 1977; Bourdieu & Passeron, 1977; Bowles & Gintis, 1976; Giroux, 1983; Karabel & Halsey, 1977; Valli, 1986; Whitty & Young, 1976; Willis, 1977; Young & Whitty, 1977). Neither line of research provides answers to the question of what the cultural determinants of group differences in mathematics performance are. Both, however, provide powerful ways to look at the question.

The point in bringing up culture-practice theory is not simply to call for more cross-cultural research on group differences in mathematics (although there is clearly a need for more cross-cultural research). Instead, I want to emphasize the assumption of "context specificity" which is at the base of the theory. Advocates of culture-practice theory argue that the cross-cultural differences in

cognition which have often been found are not the result of some developmental deficit of the people within a particular culture. Instead, culture-practice theorists believe that the context of the assessment (including stimulus familiarity and task familiarity) can mask the competence of a particular group of people. They argue that "great care . . . must be taken [in studying cognition] to embody problems in materials and procedures whose 'fit' with indigenous experience is made part of the research design" (Laboratory of Comparative Human Cognition, 1983, p. 325). Research reviewed by the Laboratory of Comparative Human Cognition (1983) demonstrates that, given contexts more relevant to the everyday life of a culture, apparent deficits in cognition disappear. For example, unschooled Liberians (Mano), who had been described as lacking the ability to classify because they performed poorly when sorting geometric shapes, outperformed American subjects and demonstrated classification abilities when the material to be sorted was changed to rice (Irwin, Schafer, & Feiden, 1974). An example of the importance of task (rather than stimulus) familiarity is a study comparing the memory of Mayan and American 9-year-olds (Rogoff & Waddell, 1980). The previously reported Mayan memory deficit (when compared to American children) disappeared when the memory task was changed to require more of the spatial organization strategies familiar to Mayan children (rather than the rehearsal strategies used by American children).

Culture-practice theory has not by any means solved all the problems of the study of culture and cognition. In fact, advocates of the theory admit their problem of adequately accounting for the generalization of cognitive abilities across contexts. However, the theory provides valuable ideas for mathematics education researchers interested in group differences in performance within our own culture. Recognizing the effect of context on performance has important implications for the questions that should be asked, for example, in studies of sex differences. The majority of the mathematics education research on sex differences would suggest a question such as: What elements of the culture cause male adolescents to outperform female adolescents on mathematics achievement tests? But from the perspective of culture-practice theory, one would ask: What specific contexts can be found in which female adolescents demonstrate the mathematical abilities that are masked on typical school tasks in typical school environments? It is not merely a different way to state the question but a fundamentally different way to look at the problem.

Research by Fennema and Peterson (1984, 1985) in which girls seemed to be better able to demonstrate their competence when cooperative (rather than competitive) tasks were emphasized is just one example of the importance of looking at task and stimulus familiarity in mathematics education research. The point is that studies of <u>everyday</u>

cognition (see also Rogoff & Lave, 1984), while not providing answers to the question of group differences, have at least clearly demonstrated the fact that students often reveal in everyday contexts the competence that has not been revealed in typical school contexts.

The critical sociologists of education point us in a slightly different direction. (See Reyes & Stanic, 1988, for a more extensive discussion.) Called the new sociology of education in the early 1970s, this tradition is based on the attempt to explain why, despite the meritocratic ideology of schools and our society, fundamental inequalities in school performance and societal position persist for certain groups--including females, blacks, and people of low social class. Why, they ask, should sex, race, and social class have so much to do with receiving the benefits of schools and society? Critical sociologists (e.g., Apple, 1979) have studied the hidden curriculum of schools, exemplified both in the norms, values, and beliefs underlying social relations and in the formal corpus of school knowledge. And they have attempted to make connections between the culture of schools and the wider society.

While advocates of culture-practice theory would ask us to look for contexts in which group performance better reflects underlying competence, the critical sociologists would lead us to ask why there is differential access to experiences (i.e., stimuli and tasks) within our culture and

whether this differential access is inevitable or simply inappropriate and unjust. Furthermore, whether the culture inside or outside schools is being studied, the critical sociologists remind us that people are not passive recipients of cultural messages. Instead, people accept some messages, mediate others, and struggle with and resist still others. It is also true that cultural messages conflict with each other. There may be a dominant culture, but culture is not uniform and cultural messages are not all consistent. Following the work of the critical sociologists, mathematics education researchers would look for cultural inconsistencies and examples of resistance, not just to understand but to overcome inequitable access to experiences. Interestingly, the same work by Fenemma and Peterson (1984, 1985) on cooperative vs. competitive environments which was cited as a beginning for studying the effects of context also provides a springboard for studying resistance. A great deal could be learned, for example, by studying classrooms in which the teachers and students "resist" the dominant cultural message that learning environments are and should be competitive in nature.

## Conclusion

I chose for my example of research in mathematics education which could be related to the ideas of context specificity and resistance a study of children in school. Clearly, there is a need, as I said before, to use these

ideas in studies about sex differences in mathematics which look outside the school and attempt to study the relations between the culture inside and outside schools.

It seems to me that the idea of recognizing the importance of context (and stimulus/task familiarity) is taking hold in other areas, though not necessarily motivated by culture-practice theory. A good example, I think, is the work of Carol Gilligan (1982) on sex differences in moral development. But as important as the study of how different contexts can lead to different performance is the study of inequitable distribution of contexts.

Culture-practice thoery and critical sociology of education, while providing valuable insight, have not resolved the equity issues we face. Our task is not to borrow but to reconstruct the insights of others. It is time for researchers in mathematics education to move beyond intuitively appealing speculation to a more serious study of culture and its effects on performance.

## References


Apple, M. W. (1979). Ideology and curriculum. London: Routledge & Kegan Paul.

Apple, M. W. (Ed.). (1982a). Cultural and economic reproduction in education: Essays on class, ideology and the state. London: Routledge & Kegan Paul.

Apple, M. W. (1982b). Education and power. London: Routledge & Kegan Paul.

Apple, M. W. (1986). Teachers and texts: A political economy of class and gender relations in education. New York: Routledge & Kegan Paul.

Apple, M. W., & Weis, L. (Eds.). (1983). Ideology and practice in schooling. Philadelphia: Temple University Press.

Becker, J. R. (1981). Differential treatment of females and males in mathematics classes. Journal for Research in Mathematics Education, 12, 40-53.

Bernstein, B. (1977). Class, codes and control: Vol. 3. Towards a theory of educational transmissions (2nd ed.). London: Routledge & Kegan Paul.

Bourdieu, P., & Passeron, J. (1977). Reproduction in education, society and culture. London: Sage.

Bowles, S., & Gintis, J. (1976). Schooling in capitalist America: Educational reform and the contradictions of economic life. New York: Basic Books.

Fennema, E., & Meyer, M. R. (in press). Gender, equity and mathematics. In W. G. Secada (Ed.), Equity in education. London: Falmer.

Fennema, E., & Peterson, P. L. (1984). Classroom processes, sex differences, and autonomous learning behaviors in mathematics (National Science Foundation Contract No. SED 8109077). Madison, WI: University of Wisconsin-Madison.

Fennema, E., & Peterson, P. L. (1985). Autonomous learning behavior: A possible explanation of gender-related differences in mathematics. In L. C. Wilkinson & C. B. Marrett (Eds.), Gender influences in classroom interaction (pp. 17-35). Orlando, FL: Academic Press.

Fennema, E., Reyes, L. H., Perl, T. H., & Konsin, M. A. (1980, April). Cognitive and affective influences on the development of sex-related differences in mathematics. Paper presented at the annual meeting of the American Educational Research Association, Boston.

Gilligan, C. (1982). In a different voice: Psychological theory and women's development. Cambridge, MA: Harvard University Press.

Giroux, H. (1983). Theories of reproduction and resistance in the new sociology of education: A critical analysis. Harvard Educational Review, 53, 257-293.

Irwin, M. H., Schafer, G. N., & Feiden, C. P. (1974). Emic and unfamiliar category sorting of Mano farmers and U. S. undergraduates. Journal of Cross-Cultural Psychology, 5, 407-423.

Karabel, J., & Halsey, A. H. (Eds.). (1977). Power and ideology in education. New York: Oxford University Press.

Laboratory of Comparative Human Cognition. (1983). Culture and cognitive development. In P. H. Mussen & W. Kessen (Eds.), Handbook of child psychology (4th ed.). Volume I: History, theory, and methods (pp. 295-356) New York: Wiley.

Meyer, M. R., & Fennema, E. (1988). Girls, boys, and mathematics. In T. R. Post (Ed.), Teaching mathematics in grades K-8: Research based methods (pp. 406-423). Boston: Allyn & Bacon.

Reyes, L. H. (in press). Classroom processes, sex of student, and confidence in learning mathematics. Journal for Research in Mathematics Education.

Reyes, L. H., & Stanic, G. M. A. (1988). Race, sex, socioeconomic status, and mathematics. Journal for Research in Mathematics Education, 19, 26-43.

Rogoff, B., & Lave, J. (Eds.). (1984). Everyday cognition: Its development in social context. Cambridge, MA: Harvard University Press.

Rogoff, B., & Waddell, K. J. (1980). Memory of an organized scene: A cross-cultural comparison. Paper presented at the meeting of the Western Psychological Association, Honolulu.

Senk, S., & Usiskin, Z. (1983). Geometry proof writing: A new view of sex differences in mathematics ability. American Journal of Education, 91, 187-201.

Smith, S. E., & Walker, W. J. (1988). Sex differences on New York State Regents examinations: Support for the differential course-taking hypothesis. Journal for Research in Mathematics Education, 19, 81-85.

Stanic, G. M. A. (1988, February). Cultural determinants of sex differences in mathematics achievement. Paper presented at the annual meeting of the American Association for the Advancement of Science, Boston.

Tobin, K. (1984, August). Classroom processes. Paper presented at the Fifth International Congress on Mathematical Education, Adelaide, Australia.

Vader, J. E. (1987, November 23). Big plus for females. Sports Illustrated, p. 100.

Valli, L. (1986). Becoming clerical workers. Boston: Routledge & Kegan Paul.

Ward, L. F. (1883). Dynamic sociology, or applied social science as based upon statistical sociology and the less complex sciences (Vol. 2). New York: Appleton.

Whitty, G., & Young, M. (Eds.). (1976). Explorations in the politics of school knowledge. Nafferton, England. Nafferton Books.

Willis, P. E. (1977). Learning to labour: How working class kids get working class jobs. Farnborough, England: Saxon.

Young, M., & Whitty, G. (Eds.). (1977). Society, state and schooling: Readings on the possibilities for radical education. Lews, England: Falmer.